PROCEEDINGS

OF THE

# ACADEMY OF SCIENCES

(UNITED PROVINCES OF AGRA AND OUDH, INDIA)

SESSION 1934-35

PART V] VOL. IV [Pp. 401—447

CONTENTS



[*Continued on page iv of cover*

*July, 1935*

ALLAHABAD

PUBLISHED BY THE COUNCIL

Price Rs. 2 (India); Rs. 2/8 (Foreign).

# Council of the Academy of Sciences of the United Provinces of Agra and Oudh, Allahabad

1935

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# BUSINESS MATTERS

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*The Governor of the United Provinces of Agra and Oudh.*

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The Hon'ble Sir J. P. Srivastava, Kt., M.Sc. (Tech.)

*The Minister of Education,*

*The United Provinces of Agra and Oudh.*

Pandit Madan Mohan Malaviya, LL.D.,

*Vice-Chancellor,*

*Benares Hindu University, Benares.*

# Business Supplement

## ANNUAL MEETING

The Annual Meeting of the Academy of Sciences was held in the Physics Lecture Theatre, Muir College Buildings, Allahabad, at 3 p.m. on Wednesday, February 27, 1935. Dr. Sir L. L. Fermor, Kt., O.B.E., D.Sc., A.R.S.M., M. Inst. M.M., F.G.S., F.A.S.B., F.R.S., Director, Geological Survey of India, Indian Museum, Calcutta, presided over the function. Prof. A. C. Banerji, the General Secretary, read the Annual Report of the Academy of Sciences for 1934.

Dr. K. N. Bahl, D.Sc., D.Phil., the President of the Academy, read his address. Dr. Sir L. L. Fermor, then delivered his address.

Dr. P. L. Srivastava proposed a vote of thanks to the outgoing President, Dr. K. N. Bahl, and the outgoing Secretary, Mr. A. C. Banerji, and Dr. Tara Chand seconded the vote. Prof. M. N. Saha proposed a vote of thanks to Dr. Sir L. L. Fermor and Dr. H. R. Mehra seconded it.

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# SECRETARIES' REPORT

**Prof. A. C. Banerji**

We have the honour to submit the following report on the working of the Academy during the period beginning from the 1st of January 1934 and ending on the 31st of December, 1934.

The Third Annual Meeting of the Academy of Sciences was held in the Vizianagram Hall, Muir College Buildings, Allahabad, on Saturday, January 20, 1934 at 4 p.m. The Hon'ble Sir Shah Mohammad Sulaiman, Kt., M.A., LL.D., Chief Justice, High Court, Allahabad, presided over the function. His Excellency Sir William Malcolm Hailey, the Patron of the Academy, and the Hon'ble Mr. J. P. Srivastava, the Minister of Education, U.P., sent messages befitting the occasion.

We are glad to record the steady progress that the Academy is making both as regards its membership and the standard of its publications. The Academy has now on its roll 118 members of whom 25 are

Non-resident members. The journal of the Academy has received good recognition in India as well as outside India. Its name has now been changed from "The Bulletin of the Academy of Sciences" to "The Proceedings of the Academy of Sciences, U. P." We are now receiving 104 foreign and Indian scientific journals in exchange.

We are much indebted to Government for the non-recurring grant of Rs. 2,000, which was received in December last, for the financial year 1934-35. The Academy also owes a debt of gratitude to Sir Shah Mohammad Sulaiman for his handsome donation of Rs. 400 to it. Sir Shah Mohammad read a paper on the Mathematical Theory of Relativity before the Academy which has attracted notice of Scientists in India and abroad, and an appreciative note on his theory was published in the American scientific journal "SCIENCE".

It is a matter of genuine pleasure to every Scientist that owing to the efforts of Dr. L. L. Fermor, an honourable compromise between different groups of Scientists in India has been effected and the National Institute of Sciences, India, the All-India co-ordinating scientific body, has now been founded. We are glad to mention that the U. P. Academy of Sciences has all along given active support to the establishment of such a body and has agreed to co-operate fully with the newly formed National Institute. We have been able to publish five issues of our journal during the year 1934. The number of original publications which we are receiving from different research centres of the country provides sufficient material for a few more issues, but our activities in this direction are restricted on account of financial difficulties. We have not yet been able to organise a Science Library nor publish a popular scientific journal. We hope and trust that Government will place us under further obligation by sanctioning a recurring grant of Rs. 4,000 per annum, so that we may give effect to our ideas and extend the sphere of our useful activities. The need for a building of the Academy is urgently felt, and an appeal for raising money for this purpose will have to be issued soon. With the help of Government, the Universities of these provinces, and generous public, we hope it will be possible for us to construct a suitable building for the Academy before long.

The Academy accepted with thanks the gift of eight volumes of Philosophical Magazine and Journal of Science from an anonymous donor through Mr. Ram Niwas Rai, M.Sc. Three new Fellows, *viz.*, Prof. J. C. Ghosh of Dacca, Drs. Shri Ranjan and B. N. Prasad of Allahabad, have been elected. There is a general consensus of opinion among the members of the Academy that the number of Fellows of our Academy should

not be restricted to thirty, but should be increased considerably. A committee has been formed to consider this question, to recommend changes in our rules and regulations, and to suggest a more suitable name for our Academy.

Our thanks are due to Dr. Narendranath Ghatak, D.Sc., for kindly helping us in the publication of our journal "The Proceedings of the Academy of Sciences, U.P.". He has now been appointed its Assistant Editor. We also wish to express our thanks to the other Office-bearers and the members of the Council of the Academy for their ungrudging help and active co-operation.

## ABSTRACTS OF THE PROCEEDINGS

The list of the Office-bearers and Members of the Council to which the management of the affairs of the Academy was entrusted for the year 1934-35 is given in appendix A.

Appendix B contains the list of names of members who were on the roll of the Academy on March 31st, 1935.

The Council expressed its deep gratitude to the Government for the non-recurring grant of Rs. 2,000 awarded to the Academy for the year 1934-35.

The Council considered the resolution of the General Committee of the Indian Science Congress about the adoption of Metric System throughout the whole of India and it recommended that the Government of India should be requested to adopt the System as far as possible through India.

The Council resolved that the U. P. Academy of Sciences beg to represent strongly that proper consideration was not given by the Academy Committee of the Indian Science Congress Association to the claims of the Scientists of the United Provinces and the Punjab for adequate representation in the matter of Fellowships of the proposed National Institute of Sciences (India).

The Council resolved that in the opinion of the members of the U. P. Academy of Sciences, the name of the central body should be The National Academy of Sciences of India instead of the proposed name, The National Institute of Sciences (India).

The Council resolved that the U. P. Academy of Sciences beg to lodge its protest against the use of the name—Indian Academy of Sciences by the Bangalore body as the activity of this body is mainly local and confined to South India. Further the Council was of opinion that pressure should be put on the Bangalore body to change its name to the South Indian Academy of Sciences.

The above three resolutions were confirmed by the General Body of the Academy.

The Council resolved that an Assistant Editor should be appointed who would be responsible to the Editorial Board for bringing out the Proceedings of the Academy of Sciences in proper form.

The Council gratefully acknowledged the receipt of Rs. 400 from the Hon'ble Sir Shah Mohammad Sulaiman, Kt., M.A., LL.D., Chief Justice, High Court, Allahabad, as donation to the Academy.

The Council passed the following Rules regarding the publication of papers in the Proceedings of the Academy of Sciences, U. P.:—

1. The paper should be at once sent to the local Editor who should always be the first referee.

2. The paper should be referred to a second referee along with the opinion of the local Editor. The second referee should be requested to send his report on the paper within 10 days of the date of receipt.

3. Stamped covers for sending back the articles should be despatched along with the article to the second referee.

4. If the two reports are unanimous that the paper is in a form suitable for publication it should be sent to the press for printing.

5. If there is any difference of opinion, the paper should be referred to a third referee by the local Editor. The decision of the majority regarding the publication of the paper will prevail.

6. If the referees recommend the publication of the paper in an abridged or altered form the author should be requested to alter the paper accordingly.

7. Every author should send one copy of the paper.

8. Every paper should be accompanied by a summary not exceeding 300 words.

9. When a paper is received it should at once be acknowledged.

10. A referee should be a man who will, as far as possible, be an expert on the subject. He need not necessarily be a member of the Academy of Sciences, U. P.

11. As far as possible the papers should be published in order of their dates of receipts.

The Academy of Sciences, U. P., passed a resolution of condolence in its Ordinary Meeting at the sad and sudden demise of Prof. Ganesh Prasad, the eminent Mathematician and Educationist of India and conveyed its sympathies to the members of the bereaved family.

It was resolved by the Fellows of the Academy of Sciences, U. P., that the Council of the Academy be requested to effect such changes in the constitution as will enable the Academy to increase the number of fellows from thirty to one hundred.

The following three members were elected Fellows of the Academy in the Fellows' Meeting held on November 28, 1934:

1. Prof. J. C. Ghosh, D. Sc., Professor of Chemistry, Dacca University, Dacca.

2. Dr. Shri Ranjan, D. Sc. (Toulouse), Reader in Botany, Allahabad University, Allahabad.

3. Dr. B. N. Prasad, M.Sc., D.Sc. (Paris), Ph.D., Mathematics Department, Allahabad University, Allahabad.

The following members were elected Office-bearers and the Members of the Council for the year 1935 in the Annual Meeting held on February 27, 1935 :

**President**

1. N. R. Dhar, D.Sc., F.I.C., I. E. S.

**Vice-Presidents :**

2. Prof. K. N. Bahl, D.Sc., D. Phil.
3. Prof. A. C. Banerji, M.A., M.Sc., F.R.A.S., I. E. S.

**Hony. Treasurer :**

4. Dr. H. R. Mehra, Ph. D.

**General Secretaries :**

5. Dr. S. M. Sane, B.Sc., Ph. D.
6. Dr. P. L. Srivastava, M.A., D. Phil.

**Foreign Secretary :**

7. Prof. B. Sahni, D. Sc., Sc. D., F.L.S., F. A. S. B.

**Other Members of the Council :**

8. Prof. K. C. Mehta, Ph. D.
9. Prof. M. N. Saha, F. R. S.
10. Prof. S. S. Joshi, D.Sc.
11. Prof. Ch. Wali Mohammad, M.A., Ph.D., I. E. S.
12. Dr. Shri Ranjan, D.Sc.
13. Dr. Rudolf Samuel, Ph.D.
14. Prof. J. A. Strang, M.A.
15. Prof. D. R. Bhattacharya, D.Sc., Ph.D., F. Z. S.
16. Prof. K. C. Pandya, D.Sc.

APPENDIX A

## LIST OF OFFICE-BEARERS AND MEMBERS OF THE COUNCIL 1934

### President

Prof. K. N. Bahl, D.Sc., D. Phil.

### Vice-Presidents

Prof. M. N. Saha, D.Sc., F.R.S., F.A.S.B.
Prof. B. Sahni, D.Sc., Sc.D., F.L.S., F.A.S.

### Hony. Treasurer

Prof. D. R. Bhattacharya, M.Sc., D.Sc., Ph. D.

### General Secretaries

Prof. P. S. MacMahon, B.Sc., M.Sc., F.I.C.
Prof. A. C. Banerji, M.A., M.Sc., F.A.S.B., I.E.S.

### Foreign Secretary

Prof. N. R. Dhar, D.Sc., F I.C, I.E.S.

### Other Members of the Council

Prof. Nihal Karan Sethi, D.Sc.
Dr. S. S. Nehru, M.A., Ph. D., I.C.S.
Prof. C. A. King, B.Sc., A.R.C.Sc., M.I.M.E.
Prof. Ch. Wali Mohammad, M.A., Ph. D., I.E.S.
Dr. H. R. Mehra, Ph. D.
Prof. Rudolf Samuel, Ph. D.
Dr. S. M. Sane, B.Sc., Ph. D.
Prof. C. Maya Das, B.Sc., M.A., I.A.S.
Prof. K. C. Pandya, D.Sc.

APPENDIX B

## ORDINARY MEMBERS

R—Resident. N.—Non-Resident.

*—Denotes a Fellow.

†—Denotes a Fellow of the National Institute of Sciences, India.

Alphabetical List of Ordinary Members

| Date of Election. | | |
|---|---|---|
| 17-4-1931 | R | Asundi, (R.K.), Ph.D., Reader, Physics Department, Muslim University, Aligarh. |
| 1-1-1930 | †R* | Bahl, (K.N.), D.Phil., D.Sc., Professor of Zoology, Lucknow University, Lucknow. |
| 1-1-1930 | †R* | Banerji, (A.C.), M.A., M.Sc., F.R.A.S., I.E.S., Professor of Mathematics, Allahabad University, Allahabad. |
| 29-2-1932 | R | Banerji, (G.N.), The Scientific Instrument Company Ltd., Albert Road, Allahabad. |
| 22-12-1932 | †N | Banerji, (S.K.), D.Sc., Meteorological Office, Ganeshkhind Road, Poona 5. |
| 17-4-1931 | N | Basu, Saradindu, M.Sc., Meteorologist, Ganeshkhind Road, Poona 5. |
| 19-3-1931 | R | Bhargava, Saligram, M.Sc., Reader, Physics Department, Allahabad University, Allahabad. |
| 17-4-1931 | R | Bhargava, Vashishta, M.Sc., I.C.S., Assistant Magistrate and Collector, Budaun. |
| 17-4-1931 | R | Bhatia, (K.B.), I.C.S , Joint Magistrate, Shahjahanpur. |
| 21-4-1933 | †N* | Bhatnagar, (S.S.), D.Sc., Professor of Chemistry, Government College, Lahore. |
| 20-12-1934 | R | Bhattacharya, (A.K.), D.Sc., Chemistry Department, Allahabad University, Allahabad. |
| 1-1-1931 | †R* | Bhattacharya, (D.R.), M.Sc., Ph.D., Docteur ès Sciences, Professor of Zoology, Allahabad University, Allahabad. |
| 17-4-1931 | R | Bhattacharya, (D.P.), M.Sc., Bareilly College, Bareilly. |
| 3-4-1933 | R | Chand, Tara, M.A., D. Phil., Principal, K. P. University College, Allahabad. |
| 29-2-1932 | R | Charan, Shyama, M.A., M.Sc., Agra College, Agra. |

| Date of Election. | | Alphabetical List of Ordinary Members |
|---|---|---|
| 1-1-1930 | R* | Chatterji, (G.), M.Sc., Meteorologist, Upper Air Observatory, Agra. |
| 17-4-1931 | R | Chatterji, (K.P.), M.Sc., A.I.C., F.C.S., Reader, Chemistry Department, Allahabad University, Allahabad. |
| 17-4-1931 | R | Chatterji, (A.C.), D.Sc., Chemistry Department, Lucknow University, Lucknow. |
| 9-2-1934 | R | Chaturvedi, Champa Ram, Pandit, Professor of Mathematics, St. John's College, Agra. |
| 19-3-1931 | R | Chaudhury, Rabindra Nath, M.Sc., M.A., Mathematics Department, Allahabad University, Allahabad. |
| 17-1-1931 | R | Chaudhury, (H.P.), M.Sc., Lucknow University, Lucknow. |
| 19-3-1931 | R | Das, Ramsaran, D.Sc., Zoology Department, Allahabad University, Allahabad. |
| 17-4-1931 | R | Das, C. Maya, M.A., B.Sc., I.A.S., Principal, Agricultural College, Cawnpore. |
| 28-10-1932 | N | Das, (A.K.), D Sc., Alipore Observatory, Alipore, Calcutta. |
| 22-12-1932 | N | Das, (B.K.), D.Sc., Professor of Zoology, Osmania University, Hyderabad, Deccan. |
| 15-9-1931 | R | Dasannacharya, (B.), Ph.D, Professor of Physics, Benares Hindu University, Benares. |
| 17-4-1931 | R | Deodhar, (D.B.), Ph.D., Reader, Physics Department, Lucknow University, Lucknow. |
| 17-4-1931 | R | Dey, (P.K.), M Sc., I.A.S., Plant Pathologist to Government, United Provinces, Nawabganj, Cawnpore. |
| 29-2-1932 | R | Deb, Suresh Chandra, D.Sc., Research Physicist, Bose Institute, Calcutta. |
| 1-1-1930 | †R* | Dhar, (N.R.), D.Sc., Docteur ès Sciences, F.I.C, Professor of Chemistry, Allahabad University, Allahabad. |
| 19-3-1931 | R | Dutt, (S.K.), M.Sc., Zoology Department, Allahabad University, Allahabad. |
| 17-4-1931 | R | Dutt, (S.B.), D.Sc., Reader, Chemistry Department, Allahabad University, Allahabad. |
| 28-10-1932 | R | Dutt, (A.K.), D.Sc., Bose Institute, Calcutta. |
| 22-2-1933 | R | Ghatak, Narendranath, M.Sc., D.Sc., Chemistry Department, Allahabad University, Allahabad. |
| 19-4-1931 | R | Ghosh, (B N.), M.Sc., St. Andrew's College, Gorakhpur. |

| Date of Election. | | Alphabetical List of Ordinary Members. |
|---|---|---|
| 8-11-1933 | †N* | Ghosh, (J.C.), D.Sc., The University, Dacca. |
| 19-3-1931 | R | Ghosh, (R.N.), D.Sc., Physics Department, Allahabad University, Allahabad. |
| 19-3-1931 | R | Ghosh, Satyeshwar, D.Sc., Chemistry Department, Allahabad University, Allahabad. |
| 15-9-1931 | N | Gogate, (D.V.), M.Sc., Baroda College, Baroda. |
| 15-9-1931 | R | Gordon, (C.B.), B.A, Christ Church College, Cawnpore. |
| 17-4-1931 | R | Gupta, (B.M.), Ph.D., Deputy Public Analyst to Government, United Provinces, Lucknow. |
| 21-12-1931 | R | Hansen, (W.J.), M.A., Allahabad Agricultural Institute, Naini, E.I.R., Allahabad. |
| 17-4-1931 | R | Higginbottom, Sam, D.Phil., Principal, Allahabad Agricultural Institute, Naini, E.I.R., Allahabad. |
| 17-4-1931 | R* | Hunter, Robert, (F.), D.Sc., Ph.D., Professor of Chemistry, Muslim University, Aligarh. |
| 3-4-1934 | R | Joshi, (A.D.), P.E.S., Lecturer, Training College, Allahabad. |
| 21-12-1931 | R | Joshi, (S.S.), D.Sc., Professor of Chemistry, Benares Hindu University, Benares. |
| 15-9-1931 | N | Kichlu, (P.K.), D.Sc., Department of Physics, Government College, Lahore. |
| 1-1-1930 | †R* | King, (C.A.), B.Sc. (Hons.), A.R.C.Sc., M.I.M.E., Principal, Engineering College, Benares Hindu University, Benares. |
| 21-4-1933 | N | Kishen, Jai, M.Sc., Professor of Physics, S.D. College, Lahore. |
| 9-2-1934 | N | Kothari, (D.S.), M.Sc., Ph.D., Professor of Physics, The University, Delhi. |
| 3-4-1934 | †R | Krishna, Shri. (Dr.), Chemist, Forest Research Institute, New Forest, Dehra Dun. |
| 5-10-1933 | R | Kureishy, (A.M.), M.A., Reader in Mathematics, Muslim University, Aligarh. |
| 1-1-1930 | R* | Luxmi Narayan, D.Sc., Reader, Mathematics Department, Lucknow University, Lucknow. |
| 1-1-1930 | †R* | MacMahon, (P.S.), B.Sc. (Hons.), M.Sc., Professor of Chemistry, Lucknow University, Lucknow. |
| 26-9-1934 | R | Malaviya, Braj Kishore, M.Sc., Lok Nath, Allahabad. |

| Date of Election. | | Alphabetical List of Ordinary Members |
|---|---|---|
| 1-1-1930 | †R* | Mathur, (K.K.), B.Sc. (Hons.), A.R.S.M., Professor of Geology, Benares Hindu University, Benares. |
| 1-1-1930 | †R* | Mehta, (K.C.), Ph.D., M.Sc., Agra College, Agra. |
| 1-1-1930 | R* | Mitter, (J.H.), M.Sc., Ph.D., Professor of Botany, Allahabad University, Allahabad. |
| 15-9-1931 | R | Mathur, (L.P.), M.Sc., St. John's College, Agra |
| 8-11-1933 | N | Mathur, Ram Behari, M.Sc., Professor of Mathematics, St. Stephen's College, Delhi. |
| 19-3-1931 | R | Mazumdar, Kanakendu, D.Sc., Physics Department, Allahabad University, Allahabad. |
| 19-3-1931 | †R* | Mehra, (H.R.), Ph.D., Reader, Zoology Department, Allahabad University, Allahabad. |
| 21-12-1931 | R | Mehta, (N.C.), I.C.S., Collector, Muzaffarnagar, U.P. |
| 21-4-1933 | N | Mela Ram, M.Sc., Asst. Professor of Physics, Foreman Christian College, Lahore. |
| 21-4-1933 | N | Mukerjee, Ashutosh, M.A., Principal, Science College, P. O. Bankipore (Patna). |
| 22-2-1933 | R | Narliker, (V.V.), M.A., Professor of Mathematics, Benares Hindu University, Benares. |
| 17-4-1931 | R | Nehru, (S.S.), M.A., Ph.D., I.C.S., M.L.C., Deputy Secretary to Government, U.P., Publicity Department, Lucknow. |
| 17-4-1931 | R | Panday, (K.C.), D.Sc., St. John's College, Agra. |
| 3-4-1933 | N | Parija, (P.K.), M.A., I.E.S., Ravenshaw College, Cuttack. |
| 5-10-1933 | R | Prasad, Gorakh, D.Sc., Reader in Mathematics, Allahabad University, Allahabad. |
| 21-4-1933 | N | Prasad, Kamta, M.A., M.Sc., Professor of Physics, Science College, P.O. Bankipore (Patna). |
| 15-9-1931 | N | Prasad, Mata, D.Sc., Royal Institute of Science, Bombay. |
| 3-4-1933 | R* | Prasad, Badrinath, Ph.D., Docteur ès Sciences, Mathematics Department, Allahabad University, Allahabad. |
| 17-4-1931 | R | Puri, (B.D.), M.A., Thomason Civil Engineering College, Roorkee. |
| 22-12-1932 | †N | Qureshi (M.), M.Sc., Ph.D., Professor of Chemistry, Osmania University College, Hyderabad, Deccan. |

| Date of Election. | | Alphabetical List of Ordinary Members |
|---|---|---|
| 20-12-1934 | R | Rai, Ram Niwas, M.Sc., Physics Department, Allahabad University, Allahabad. |
| 3-4-1933 | R | Raja Ram, M.A., B.E., Malarial Engineer, Kasauli. |
| 19-3-1931 | R* | Ranjan, Shri, M.Sc., Docteur ès Sciences, Reader, Botany Department, Allahabad University, Allahabad. |
| 15-9-1931 | N | Rao, A. Subba, D.Sc., Medical College, Mysore. |
| 22-2-1933 | N | Rao, G. Gopala, B.A., M.Sc., Chemistry Department, Andhra University, Waltair. |
| 21-12-1931 | R | Rao, D. H. Ramchandra, B.E., A.M.I.E., Engineer, Allahabad University, Allahabad. |
| 14-3-1934 | N | Rao, K. Rangadhama, D.Sc., Physics Department, Andhra University, Waltair. |
| 22-2-1933 | N | Ray, Bidhubhusan, D.Sc., 92 Upper Circular Road, Calcutta. |
| 21-12-1931 | R | Ray, Satyendra Nath, M.Sc., Physics Department, Lucknow University, Lucknow. |
| 1-1-1930 | R* | Richards, (P.B.), A.R.C.S., F.E.S., Entomologist to the Government, United Provinces, Cawnpore. |
| 1-1-1930 | †R* | Saha, (M.N.), D.Sc., F.R.S., F.A.S.B., F.Inst.P., P.R.S., Professor of Physics, Allahabad University, Allahabad. |
| 29-2-1932 | R | Saha, Jogendra Mohan, M.Sc., Manager, Srikrishna Desi Sugar Works, Jhusi, (Allahabad). |
| 1-1-1930 | †R* | Sahni, (B.), D.Sc., Sc.D., F.L.S., F.A.S.B., Professor of Botany, Lucknow University, Lucknow. |
| 17-4-1931 | R* | Samuel, Rudolf, Ph.D., Professor of Physics, Muslim University, Aligarh. |
| 17-4-1931 | R | Sane, (S.M.), B.Sc., Ph.D., Reader, Chemistry Department, Lucknow University, Badshah Bagh, Lucknow. |
| 3-4-1933 | R | Sen, (K.C.), D.Sc., Imperial Institute of Veterinary Research, Muktesar, Kumaun. |
| 20-12-1934 | N | Sen Gupta, (P.K.), M.Sc., Professor of Physics, Rajaram College, Kolhapur. (Bombay Presidency) |
| 21-4-1933 | N | Seth (J.B.), M.A., Government College, Lahore. |
| 17-4-1931 | R | Seth, (S.D.), M.Sc., Christ Church College, Cawnpore. |

| Date of Election. | | Alphabetical List of Ordinary Members |
|---|---|---|
| 1-1-1930 | R* | Sethi, (R.L.), M.Sc., M.R.A.S., Economic Botanist to Government, United Provinces, Cawnpore. |
| 19-3-1931 | R | Sethi, Nihal Karan, D.Sc., Agra College, Agra. |
| 3-4-1934 | R | Shah, (S.M.), M.A. (Lond.), Mathematics Department, Muslim University, Aligarh, U.P. |
| 15-9-1931 | R | Sharma, Ram Kishore, M.Sc., Physics Department, Ewing Christian College, Allahabad. |
| 3-4-1933 | N | Siddiqi, (M.R.), Ph.D., Professor of Mathematics, Osmania University, Hyderabad, Deccan. |
| 3-4-1933 | R | Siddiqui, Mohd. Abdul Hamid, M.B.B.S., M.S., F.R.C.S., D.L.O., Professor of Anatomy, King George's Medical College, Lucknow. |
| 17-4-1931 | R | Singh, Avadhesh Narain, D.Sc., Department of Mathematics, Lucknow University, Lucknow. |
| 17-4-1931 | N | Soonawala, (M.F.), M.Sc., Maharaja's College, Jaipur (Rājputana). |
| 19-3-1931 | R* | Srivastava, (P.L.), M.A., D.Phil., Reader, Mathematics Department, Allahabad University, Allahabad. |
| 10-8-1933 | R | Srivastava, (R.C.), B.Sc. (Tech.), Sugar Technologist, Imperial Council of Agricultural Research, India, Cawnpore. |
| 15-9-1931 | N | Srikantia, (C.), B.A., D.Sc., Medical College, Mysore. |
| 19-12-1933 | R | Strang, (J.A.), M.A., B.Sc., Professor of Mathematics, Lucknow University, Badshah Bagh, Lucknow. |
| 24-1-1933 | N | Subramanian, (S.), M.A., Mathematics Department, Annamalai University, Annamalainagar P.O, South India. |
| 17-4-1931 | R | Sulaiman, (S.M.), Hon'ble Sir, Chief Justice, High Court, Allahabad. |
| 19-3-1931 | R | Taimini, Iqbal Kishen, Ph.D., Chemistry Department, Allahabad University, Allahabad. |
| 19-3-1931 | R | Tewari, Shri Govind, M.A., Mathematics Department, Allahabad University, Allahabad. |
| 3-4-1933 | R | Thompson, (C.D.), M.A., Professor of Economics, Allahabad University. |
| 19-3-1931 | R | Toshniwal, (G.R.), M.Sc., Physics Department, Allahabad University, Allahabad. |

| Date of Election. | | Alphabetical List of Ordinary Members |
|---|---|---|
| 3-4-1934 | R | Varma, Rama Shanker, M.Sc., Christ Church College, Cawnpore. |
| 20-12-1934 | R | Varma, (S.C.), M.Sc., Zoology Department, Allahabad University, Allahabad. |
| 9-2-1934 | R | Vaugh, Mason, B.Sc., Ing., Agricultural Engineer, Allahabad Agricultural Institute, Naini, E.I.Ry. (Allahabad.) |
| 19-3-1931 | †N* | Vijayaraghavan, (T.), D.Phil., Reader, Mathematics Department, Dacca University, Ramna, Dacca. |
| 1-1-1930 | †R* | Wali Mohammad, Ch., M.A., Ph.D., I.E.S., Professor of Physics, Lucknow University, Lucknow. |
| 15-9-1931 | R | Wall, (W. G. P.), M.Sc., I.E.S., Associate I.E.E., M.R.S.T., Principal, Training College, Allahabad. |

*N.B.*—The Secretaries will be highly obliged if the members will kindly bring to their notice errors, if there be any, in their titles, degrees, and addresses.

## LIST OF EXCHANGE JOURNALS

| | Journals | Publishers |
|---|---|---|
| 1. | The Bell System Technical Journal ... | The American Telephone and Telegraph Coy., New York, (U. S. A.) |
| 2. | Proceedings of the Imperial Academy of Japan. | The Imperial Academy, Ueno Park, Tokyo. |
| 3. | Journal of the Franklin Institute ... | The Franklin Institute of the State of Pennsylvania, Philadelphia, Penna, (U. S. A.) |
| 4. | Bell Telephone System (Technical Publications). | The Bell Laboratories, New York. |
| 5. | Collected Researches of the National Physical Laboratory. | The National Physical Laboratory, Teddington, Middlesex, England. |
| 6. | Report of the National Physical Laboratory. | Ditto. |
| 7. | The Electrician .. ... ... | The Electrician, Bouverie House, London. |
| 8. | Proceedings of the Cambridge Philosophical Society. | The Philosophical Society, Cambridge. |
| 9. | Proceedings of the Royal Society of Edinburgh. | The Royal Society of Edinburgh, Edinburgh, Scotland. |
| 10. | Journal and Proceedings of the Asiatic Society of Bengal. | The Asiatic Society of Bengal, Calcutta. |
| 11. | Indian Journal of Physics | The Indian Association for Cultivation of Science, Calcutta. |
| 12. | Scientific Notes of the India Meteorological Department. | The Director-General of Observatories, Poona 5. |
| 13. | Memoirs of the India Meteorological Department. | Ditto. |
| 14. | Journal of the Egyptian Medical Association. | The Egyptian Medical Association, 3 Sharia El-Sanafiri, Abdin, Cairo, Egypt. |
| 15. | Bulletin of the Patna Science College Philosophical Society. | The Patna Science College Philosophical Society, Patna. |
| 16. | Journal of the Indian Institute of Science. | The Indian Institute of Science, Bangalore. |
| 17. | Current Science... ... ... | The Indian Institute of Science, Bangalore. |
| 18. | Transactions of the Royal Society of Canada. | The Royal Society of Canada, Ottawa. |
| 19. | Publications of the Kapteyn Astronomical Laboratory. | Kapteyn Astronomical Laboratory, Gröningen, Holland. |

| | Journals | Publishers |
|---|---|---|
| 20. | Publications of the Dominion Astrophysical Observatory. | The Dominion Astrophysical Observatory Victoria, Canada. |
| 21. | Dominion of Canada Natural Research Council | Ditto. |
| 22. | Proceedings of the Royal Society of Victoria. | The Royal Society of Victoria, Melbourne, Australia. |
| 23. | Journal and Proceedings of the Royal Society of New South Wales. | The Royal Society of New South Wales, Sydney, Australia. |
| 24. | Transactions and Proceedings of the New Zealand Institute. | The New Zealand Institute, Wellington, New Zealand. |
| 25. | Publications of the Alleghany Observatory. | The Alleghany Observatory of the University of Pittsburgh, Alleghany City, (U.S.A.) |
| 26. | Publications of the Observatory of the University of Michigan. | The Observatory Library, University of Michigan, Michigan (U. S. A.) |
| 27. | Lick Observatory Bulletin... ... | The Lick Observatory, University of California, Berkeley (U. S. A.) |
| 28. | Proceedings of the American Academy of Arts and Sciences. | The American Academy of Arts and Sciences, Boston (U. S. A.) |
| 29. | Memoirs of the American Academy of Arts and Sciences. | Ditto. |
| 30. | Journal of Mathematics and Physics. | The Massachusetts Institute of Technology, Cambridge, Mass (U. S. A.) |
| 31. | Proceedings of the National Academy of Sciences. | The National Academy of Sciences, Washington (U. S. A.) |
| 32. | Biographical Memoirs ... ... | Ditto. |
| 33. | Proceedings of the Academy of Natural Sciences of Philadelphia. | The Academy of Natural Sciences, Philadelphia (U. S. A.) |
| 34. | Sinensia ... ... ... | The Metropolitan Museum of Natural History Academia Sinica, Nanking, China. |
| 35. | Proceedings of the American Philosophical Society. | The American Philosophical Society, Philadelphia (U. S. A.) |
| 36. | American Journal of Science ... | The American Journal of Science, New Haven (U. S. A.) |
| 37. | Bureau of Standards, Journal of Research. | The Director, Deptt. of Commerce, Bureau of Standards, Washington (U. S. A.) |
| 38. | Contributions from the Mount Wilson Observatory. | The Mount Wilson Observatory, Pasadena, California (U. S. A ) |
| 39. | Communications (Solar Observatory) | Ditto. |
| 40. | Annual Report of the Director of the Mount Wilson Observatory. | Ditto. |

| | Journals | Publishers |
|---|---|---|
| 41. | Journal of Chemical Physics ... | The American Institute of Physics, New York, N. Y. |
| 42. | Review of Scientific Instruments ... | Ditto. |
| 43. | Transactions of the Astronomical Observatory of Yale University. | The Astronomical Observatory of Yale University, New Haven (U. S. A.) |
| 44. | Publications in Zoology ... ... | The University Library, Exchange Deptt., Berkeley, California (U. S. A.) |
| 45. | The Philippine Journal of Science ... | The Library, Bureau of Science, Manila, P. I. (U. S. A.) |
| 46. | Anzeiger (Mathematics and Science). | Akademie der Wissenschaften, Vienna, Austria. |
| 47. | Almanack ... ... ... | Ditto. |
| 48. | Anzeiger (Philosophy and History). | Ditto. |
| 49. | Bulletin de La Classe Des Sciences | The Academie Royale de Belgique, Brüssels, Belgium. |
| 50. | Annales De L'Institute Henri Poincare. | The Institute Henri Poincare, Paris (France). |
| 51. | Mathematische Und Naturwissenschaftliche Berichte Ana Ungaru. | The Ungarische Akademie der Wissenschaft, Buda-Pest, Hungary. |
| 52. | Sitzungsberichte Der Preussischen Akademie. | Preussischen Akademie der Wissenschaften, Berlin, Germany. |
| 53. | Berichte Der Deutschen Chemischen Gesellschaft. | Deutsche Chemische Gesellschaft, Berlin, Germany. |
| 54. | Nachrichten Von der Gesellschaft der Wissenschaften Zu Gottingen Mathematisch-Physikalische Klasse. Fachgruppe I. Mathematik. | Gesellschaft der Wissenschaften Zu Göttingen, Göttingen, Germany. |
| 55. | „ II. Physik, Astronomie. Geophysik, Technik. | Ditto. |
| 56. | „ III. Chemie, Einschl. Physikalische Chemie. | Ditto. |
| 57. | „ IV. Geologie und Mineralogie. | Ditto. |
| 58. | „ VI. Biologie | Ditto. |
| 59. | Jahresbericht 1933/34 | Ditto. |
| 60. | Geschaftliche Mitteilungen ... | Ditto. |
| 61. | Mathematische Naturwissenschaftliche Klasse. | Bibliothekar, Heidelberger Akademie der Wissenschaften, Heidelberg, Germany. |
| 62. | Berichte Der Mathematische Physischen Klasse. | Sachsische Akademie der Wissenschaften, Leipzig. C. I. |
| 63. | Abhandlungen Der Mathematisch-Physischen Klasse | Ditto. |

| | Journals | Publishers |
|---|---|---|
| 64. | Sitzungsberichte der Mathematisch-Naturwissenschaftlichen. | Bayerische Akademie der Wissenschaften Zu München, München, Germany. |
| 65. | Communications from the Physical Laboratory, Leiden. | The Physical Laboratory, Leiden, Holland. |
| 66. | Supplement, Communications from the Kamerlingh Onnes Laboratory. | Ditto. |
| 67. | Rendiconti | Rendiconti Del Circolo Mathematico Di Palermo, Palermo (Italy). |
| 68. | National Research Council of Japan, Report. | The National Research Council of Japan, Tokyo, Japan. |
| 69. | Japanese Journal of Mathematics ... | Ditto. |
| 70. | Japanese Journal of Botany ... | Ditto. |
| 71. | Japanese Journal of Physics ... | Ditto. |
| 72. | Japanese Journal of Astronomy and Geophysics. | Ditto. |
| 73. | Journal of the Faculty of Science. Series I, Mathematics. | The Dean of the Faculty of Science, Hokkaido, Imperial University, Sapporo, Japan. |
| 74. | Collected Work from the Faculty of Science. | The Library of the Faculty of Science, Osaka, Imperial University, Osaka, Japan. |
| 75. | Proceedings of the Physico-Mathematical Society of Japan. | The Physico-Mathematical Society of Japan, Tokyo, Japan. |
| 76. | Scientific Papers of the Institute of Physical and Chemical Research. | Institute of Physical and Chemical Research Komagome, Hongo, Tokyo. |
| 77. | Journal of Science of the Hiroshima University (Zoology). | The Hiroshima University, Hiroshima, Japan. |
| 78. | The Keijo Journal of Medicine ... | The Medical Faculty, Keijo Imperial University, Chosen, Japan. |
| 79. | Bulletin De L'Academie Des Sciences Mathematiques et Naturelles. | The Akademic der Wissenschaft, Leningrad, Soviet-Russia. |
| 80. | Journal Du Cycle De Physique et De Chemie. | Academie des Sciences D'Ukraine, Kyiv, Ukraine. |
| 81. | Journal Du Cycle Mathematique ... | Ditto. |
| 82. | Bulletin de La Classe des Sciences Physiques et Mathematiques. | Ditto. |
| 83. | Memorias Do Instituto Oswaldo Cruz. | The Instituto Oswaldo Cruz, Brazil (U.S.A.) |
| 84. | Physikalische Zeitschrift Der Sowjetunion. | Chikovsakaya 16, Kharkov, Soviet-Russia. |
| 85. | Geographical and Biological Studies of Anopheles Maculipennis in Sweden. | Kungliga Svenska Vetenskapsakademie, Stockholm, Sweden. |

| | Journals. | Publishers. |
|---|---|---|
| 86. | Kungl. Fysiografiska Sällskapets Forhandlingar. | The Universitet, Lund, Sweden. |
| 87. | Uppsala Universitets Arsskrift ... | Universitet, Uppsala, Sweden. |
| 88. | Compte Rendu Des Seances De La Societe De Physique et D'Histoire Naturelle. | Societe D'Histoire Naturelle et de Physique, Geneva, Switzerland. |
| 89. | Comptes Rendus Mensuels Des Seances De La Classe De Medecine. | Academie Polonaise Des Sciences et Des Lettres, Cracovie, Poland. |
| 90. | Comptes Rendus Mensuels Des Seances De La Classe Sciences Mathematiques et Naturelles. | Ditto. |
| 91. | Bulletin International De L'Academie Polonaise Des Sciences et Des Lettres Classe Des Sciences Mathematiques et Naturelles, Serie A. | Imprimerie De L'Universite, Cracovie, Poland. |
| 92. | Ditto Ditto Serie B. 1. | Ditto. |
| 93. | Ditto Ditto Serie B. 2. | Ditto. |
| 94. | Bulletin International De L'Academie Polonaise Des Sciences et Des Lettres Classe De Medecine. | Ditto. |
| 95. | Sprawozdania Z posiedzen Towarzystwa Naukowego Warszawskiego (History Literatury). | Societe des Sciences et des Lettres de Varsovie, Warsaw, Poland. |
| 96. | Ditto (Phisiology) | Ditto. |
| 97. | Ditto (Matematycznofizycznych) | Ditto. |
| 98. | Ditto (Biologicznych) ... | Ditto. |
| 99. | Bureau of Fisheries (Document) ... | The Commissioner of Fisheries, Washington (U.S.A.) |
| 100. | Science Bulletin ... ... | University of Kansas, Lawrence, Kansas (U.S.A.) |
| 101. | Mathematisk-Fysiske Meddelelser... | Kongelige Danske Videnskabermes Selskab, Copenhagen, Denmark. |
| 102. | Biologiske Meddelelser ... | Ditto. |
| 103. | Transactions of the Royal Society of South Africa. | The Royal Society of South Africa University of Cape-Town, Rondebosch, South Africa. |
| 104. | Comptes-Rendus des Travaux Du Laboratoire Carlsberg. | The Carlsberg Laboratorium, Kobenhavn, Valby, Denmark. |

## JOURNAL SUBSCRIBED BY THE ACADEMY OF SCIENCES, U.P., DURING THE YEAR 1934.

### PHYSICS

| | | |
|---|---|---|
| 1. | Die Naturwissenschaften. 22 Jahrgang. | Hirschwaldsche Buchhandlung, Berlin, N.W.7. |

## LIST OF PAPERS READ BEFORE THE ACADEMY OF SCIENCES, U. P., DURING THE PERIOD APRIL, 1934 TO MARCH, 1935

1. "On the Sound absorption coefficient of a few specimen", by Haji G. Mohammad, Physics Department, Allahabad University, Allahabad.
2. "The Photosynthesis of formaldehyde from 'Nascent Carbon Dioxide' in vitro and the importance of respiration in Photosynthesis," by Atma Ram, M.Sc., Chemistry Department, Allahabad University, Allahabad.
3. "The Mathematical Theory of a New Relativity", by The Hon'ble Sir Shah Mohammad Sulaiman, Kt., M.A., LL.D., Chief Justice, High Court, Allahabad.
4. "Continuous deformation of Ruled surfaces", by Prof. Ram Behari Mathur, M.A., Ph.D., Professor of Mathematics, St. Stephen's College, Delhi.
5. "Observations with an unorthodox Seismograph," by Satyendra Nath Ray, M.Sc., 14B, Hewett Road, Lucknow.
6. "On the direct formation of Bromides and the distance of the closet approach of atoms of Bromine," by Binayendra Nath Sen, 15/2 Kali Kundu Lane, Howrah (Calcutta).
7. "On changes on the Orbit of a particle when disturbed by small tangential and normal impulses", by Avadh Behari Lal, M.Sc., Ramjas College, Delhi.
8. "The variation of Viscosity during the coagulation of colloidal Aluminium hydroxide by potassium chloride solution," by Dr. S. S. Joshi and Mr. K. P. N. Pannikkar, Chemistry Department, Benares Hindu University, Benares.
9. "Chemical Examination of the Kernels of the seeds of Cæsalpinia bonducella," by Narendranath Ghatak, M.Sc., Chemistry Department, Allahabad University, Allahabad.
10. "Ionosphere Height measurement in the United Provinces of Agra and Oudh," by G. R. Toshniwal, and B. D. Pant, Physics Department, Allahabad University, Allahabad.
11. "On a new species of Catatropis, Odhner, 1905 from an Indian Fowl Gallus bankiva murghi," by Har Dayal Srivastava, M.Sc., Zoology Department, Allahabad University, Allahabad.
12. "A study of some Organic Reactions at low temperature," by Cromwell Osborn Das and S. Dutt, Chemistry Department, Allahabad University, Allahabad.
13. "Photolysis of some typical organic compounds in tropical Sunlight," by Braj Kishore Malaviya and S. Dutt, Chemistry Department, Allahabad University, Allahabad.

14. "Synthesis of alkaloids derived from cotarnine," by E. Venkata Seshacharyulu and S. Dutt, Chemistry Department, Allahabad University, Allahabad.
15. "Notes on a case of unilateral atrophy of testis in the common wall Gecko (Hemidactylus flaviviridis Ruppel)," by S. K. Dutta, M.Sc., Zoology Department, Allahabad University, Allahabad.
16. "A relation between the surface tension and the volume properties of liquids", by M. Ramanadham, M.Sc., Pillutca P.O., Via Sattenapalli, Guntur District, S. I.
17. "Cytoplasmic inclusions in the Oogenesis of Anthia sexguttata," by Murli Dhar Lal Srivastava, M.Sc., Zoology Department, Allahabad University, Allahabad.
18. "The determination of the potential function of a diatomic molecule in one of its unstable states," by Hrishikesha Trivedi, M.Sc., Physics Department, Allahabad University, Allahabad.
19. "A note on Nuclear Spins and artificial Radio-activity," by Dr. D. S. Kothari, Ph.D., Physics Department, Delhi University, Delhi.
20. "A note on uncertainty principle," Dr. D. S. Kothari, Ph.D., Physics Department, Delhi University, Delhi.
21. "A note on the convergence of the conjugate series of a Fourier Series", by Dr. B. N. Prasad, Ph.D., D.Sc., Mathematics Department, Allahabad University, Allahabad.
22. "Nitrogen fixation in Soils on application of Molasses as manure," by Dr. N. R. Dhar, S. K. Mukerjee and P. K. Kar, Chemistry Department, Allahabad University, Allahabad.
23. "Thevetin-the crystalline glucoside of Thevetia Neriifolia," by Narendranath Ghatak, M.Sc., Chemistry Department, Allahabad University, Allahabad.
24. "The effect of temperature on the Bacterial Ammonification of Urea," by S. P. Tandon, M.Sc., Chemistry Department, Allahabad University, Allahabad.
25. "New Hemiurids (Trematoda) from Indian Fresh-water Fishes Clupeailisha," Part I by Har Dayal Srivastava, M.Sc., Zoology Department, Allahabad University, Allahabad.
26. "Note on the absorption spectrum of Carbon Disulphide," by Drs. R. K. Asundi and R. Samuel, Physics Department, Muslim University, Aligarh, U. P.
27. "Chemical Examination of the roots of Citrullus Colocynthis Schrader," by Mr. Radha Raman Agarwal and Dr. S. Dutt, Chemistry Department, Allahabad University, Allahabad.
28. "On Eight New Species of the Genus Cycloceolum Brandes from North Indian Snipes," by M. Hamid Khan, M.Sc., Zoology Department, Allahabad University, Allahabad.

29. "Cytoplasmic inclusions in the Oogenesis of Scolia quadripustulatus", by Murli Dhar Lal Srivastava, M.Sc., Zoology Department, Allahabad University, Allahabad.

30. "Contributions to the Digenetic Trematodes of the Microchiroptera of Northern India." Part I.—New species of the genus Pycnoporus Looss with a note on Anchitrema Looss, by B. P. Pande, M.Sc., Zoology Department, Allahabad University, Allahabad.

31. "New Parasites of the Genus *Orientophorus*, Nov. Gen., Nov. Sp. (Family-Fellodistomidæ) from an Indian Fresh-water Fish-*Clupea ilisha*," by Har Dayal Srivastava, M.Sc., Zoology Department, Allahabad University, Allahabad.

32. "The absorption spectra of the vapours of Sulphur monochloride and Thionyl chloride," by Hrishikesha Trivedi, M.Sc., Physics Department, Allahabad University, Allahabad.

33. "The Mathematical Theory of a new Relativity," Chapters III, IV, and V, by the Hon'ble Sir Shah Muhammad Sulaiman, Kt., M.A., LL.D., Chief Justice, High Court, Allahabad.

34. "On determining Sizes of Mangum Terrace Outlets," by A. T. Mosher, M.A., Allahabad Agricultural Institute, Naini, E.I.Ry., (Allahabad).

35. "Studies on the Family Heterophyidæ Oodhner," Part II.—Four New Parasites of the Genus Haplorchis Looss, 1899, from Indian Fresh-water Fishes, by Har Dayal Srivastava, M.Sc., Zoology Department, Allahabad University, Allahabad.

36. "Studies on the Family Heterophyidæ Oodhner," Part III.—Parasites belonging to a New Genus from Indian Fresh-water Fishes, by Har Dayal Srivastava, M.Sc., Zoology Department, Allahabad University, Allahabad.

37. "The Closure property of Three Curves," by S. Subramanian, Asst. Lecturer, Annamalia University, Annamalainagar P.O., South India.

38. "Physaloptera ochari N. Sp. from Calotes Versicolor," with a short note on Abnormalities of the genus Physaloptera, by M. B. Mirza, Ph.D., Zoological Laboratories, Muslim University, Aligarh.

39. "On a property of the Parabolic Cylinder Functions," by S. C. Mitter, 35 Hatkhola Road, P. O. Wari, Dacca.

40. "Some Rare Polyporaceae of the Central Provinces," by P. R. Bhagwagar, M.Sc., Botany Department, Allahabad University, Allahabad.

41. "On the determination of absorption coefficients of sound for different materials," by Laxmi Prasad Varma, M.Sc., Physics Department, Allahabad University, Allahabad.

42. "On Sulaiman's Physical Theory of Gravitation I" by Satyendra Ray, M.Sc., 14B Hewett Road, Lucknow.

*Financial Statement – From April, 1934 to 31st March, 1935.*

| Receipts | Rs. a. p. | Rs. a. p. | Expenditure | Rs. a. p. |
|---|---|---|---|---|
| Bank Balance on 1st April, 1934 ... | | 2,249 10 9 | Establishment ... ... ... | 793 8 0 |
| U. P. Government Grant (Non-recurring) ... | | 2,000 0 0 | Honorarium to Assistant Editor ... | 150 0 0 |
| Allahabad University Grant (Non-recurring) ... | | 500 0 0 | Contingency (including printing, postage stamps and stationery, etc.,) ... | 455 4 0 |
| Donation ... ... ... ... | | 400 0 0 | Printing of Proceedings 1934-35 ... | 2,767 13 0 |
| *Membership Fee* :— | | | Binding of Journals ... ... | 84 8 0 |
| Resident membership fee for 1931 | 15 0 0 | | Furniture ... ... ... | 98 0 0 |
| Resident membership fee for 1932 | 75 0 0 | | Bank charges on outstation cheques ... | 5 4 0 |
| Resident membership fee for 1933 | 240 0 0 | | Cycle ... ... ... | 60 0 0 |
| Resident membership fee for 1934 | 540 0 0 | | Bank Balance on 31st March, 1935 ... | |
| Resident membership fee for 1935 | 105 0 0 | | Building Fund. 1,466 0 0 | |
| Part payment of subscription for 1935 ... ... | 6 0 0 | | Balance Rs. 400 5 9 | 1,866 5 9 |
| Non-resident membership fee for 1932 ... ... | 10 0 0 | | | |
| Non-resident membership fee for 1933 ... ... | 20 0 0 | | | |
| Non-resident membership fee for 1934 ... | 70 0 0 | | | |
| Non-resident membership fee for 1935 ... ... | 40 0 0 | | | |
| Associate for 1934 ... ... | 10 0 0 | 1,131 0 0 | | |
| Total Rs. ... | | 6,280 10 9 | Total Rs. ... | 6,280 10 9 |

(Sd.) H. R. Mehra, Ph. D.
*Hony. Treasurer,*
The Academy of Sciences, U. P.

**Message from His Excellency Sir Harry Haig,**
**The Patron of the Academy**

*Governor's Camp,*
*United Provinces,*
*February 28, 1935.*

*The Academy of Sciences of the United Provinces is holding its Fourth Annual Meeting and we may hope that it has now firmly established its position. I am sure that the Academy is doing important work for the advancement of Science in India, and I trust that its success will continue uninterrupted.*

*(Sd.) Harry Haig,*
*Governor,*
*United Provinces.*

**Message from the Hon'ble Sir J. P. Srivastava,**
**The Minister of Education, U. P.**

*Lucknow,*
*February 25, 1935.*

*Dear Mr. Banerji,*

*Thanks for your letter of February 18, asking me to send you a message for the Fourth Annual Meeting of the Academy of Sciences to be held at Allahabad on the 27th February. I am very sorry that it would not be possible for me to be present at this meeting, but I authorise you to tell the meeting that the Academy has my very best wishes. It is, I think, fulfilling a very useful purpose in promoting scientific research in this province and elsewhere and it is the duty of all well-wishers of the country to extend to it a helping hand. Great credit is due to the band of workers to whose enthusiasm the Academy owes its inception and existence. The Government has recognised the Academy by including in the annual schedules a grant of Rs. 2,000 for the Academy.*

*Yours sincerely,*
*(Sd.) J. P. Srivastava.*

*Prof. A. C. Banerji,*
*Allahabad University,*
*Allahabad.*

## PRESIDENT'S ADDRESS

ADDRESS OF THE PRESIDENT,

PROFESSOR K. N. BAHL,

AT THE ANNIVERSARY MEETING

*Held on February 27, 1935*

DR. FERMOR, FELLOWS AND MEMBERS OF THE ACADEMY, LADIES AND GENTLEMEN,

My very first duty as President of the U.P. Academy of Sciences is to offer a very hearty welcome to Dr. L. L. Fermor, F.R.S., for having taken the trouble of coming over to Allahabad to participate in our fourth annual meeting. Extremely busy as he is with his duties as Director of the Geological Survey of India, it is very kind of him to have come over to encourage us with his presence and advice.

The secretaries have given us an account of the working of the Academy during the year and I hope you will all agree with me that we have made the best use of our limited resources and have done good and useful work. I wish to record my very best thanks to Dr. M. N. Saha who has given of his best to the Academy and has all along zealously guarded its interests. My best thanks are also due to our energetic secretaries, Professors Banerji and Macmahon, for their cordial co-operation and assistance.

The most notable event in the history of scientific activity in India during the last year has been the inauguration of the National Institute of Sciences. Our Academy had to consider its position with regard to this all-India institution and we decided wholeheartedly to support the idea underlying the establishment of the National Institute, as it did not interfere with our individuality or independence. Now that the National Institute has been established, we have offered our cordial co-operation and it is a happy augury for the future good relations between the National Institute of Sciences and ourselves that we have the President of the Institute as our distinguished guest this afternoon.

As this is the last time I shall preside over the Academy, I wish to introduce to you my successor, Dr. N. R. Dhar, D.Sc., I.E.S., Professor of Chemistry in the University of Allahabad. He is a distinguished educationist and a chemist of great eminence. He has been associated with the Academy from its very inception and I have no doubt that he will infuse fresh life into the working of the Academy.

Last year, I spoke on the "Present Position of Darwinism," but this year I have selected a more restricted subject, namely, the "Evolution from Fish to Man" and I shall begin by stating the accepted creed of the biologist that man is merely one amongst the great hosts of animal life on this globe; he is part of an unbroken stream of life. The stream of life, that flows through our human generations and that we call man, was once a fish and it has been transformed into our present selves in about 300 million years.[1]

During these 300 million years, Nature has made many an experiment and many an invention, of which I shall select only a few and trace the human evolution through successive stages from our fish-like ancestors. Take the example of a motor-car or better that of an aeroplane—the remarkable accomplishment of the flight from London to Melbourne in less that 71 hours is still fresh in our minds—both these machines represent the high-water mark of human invention and design; the working of both of them is based on one important basic invention, namely, that of the *petrol engine.* Otto's gas-engine led to the paraffin oil engine and this in turn led to the petrol-engine of Gottlieb Daimler, who in 1887 used his petrol engine to drive a car on the road. The world has discovered in Daimler's petrol engine an appliance such as it had never possessed before; it has given man a new mobility which has changed his notions of distance and time. In due course, the petrol engine has achieved the conquest of the air.[2]

The human body is vastly more complex than any motor-car or air-ship, both in its locomotor machinery and in its instruments of precision and more than one basic invention had to be made by Nature to accomplish the evolution of man.[3] Let us consider the locomotor machinery first and start from a shark-like ancestor. Fig. 1 shows the body of the common shark of the Indian seas with a part of the skin removed to show the arrangement of the zig-zag muscle-segments.[4] Each of these muscle-segments is made up of a large number of striped muscle-

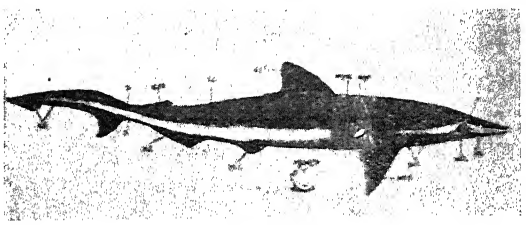

Fig. 1.—Scoliodon.

[1] Wells, Huxley and Wells.— *The Science of Life*, 1931

[2] Ewing, A.—"Power," *Nature*, Vol, 128, 1931.

[3] Gregory, W. K.—*Basic Patents in Evolution*, 1930.

[4] Thillayampalam, E. M.—"Scoliodon," *J. Z. M.*, 1928.

fibres placed horizontally. The next figure shows a few of these muscle-fibres as seen under the microscope. The muscle-fibre is really the unit of the locomotor apparatus of all vertebrates and it is by combinations of these zig-zag muscle-stripes of the shark that the complex musculature of the body and limbs of man is built up. Many of the Invertebrates have already attained to this stage and it is from them that the vertebrates have inherited their locomotor machinery. The physiology of the contraction of the muscle-fibre has been studied intensively during recent years and we now know that we can compare, as Sir Arthur Keith[1] has done, a muscle-fibre with a tiny gas-engine which utilises oxygen in its recovery stage after performing the work of shortening the muscle-fibre. Each muscle-fibre of the shark is fastened at each end to a connective tissue partition. Delicate nerve-fibres run to each of these red muscles and the contraction is so timed that a wave of contraction runs along one side of the body from the head to the tail. But soon after the first wave starts, a second begins on the opposite side, then a third on the same side and so on. It is by means of these backwardly passing waves that the fish drives its body forwards through water.

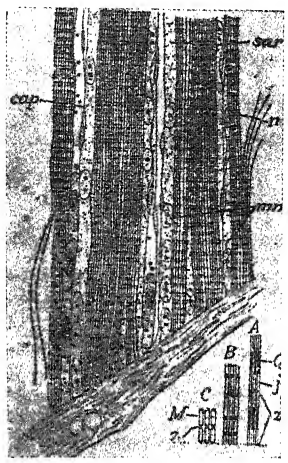


Fig. 2.—Striped muscle-fibres showing stripes.

The striped or voluntary muscle-fibre is, in fact, the basic invention of the locomotor machinery of all vertebrates,[2] like the petrol engine of the motor-car or the aeroplane. Further, like the petrol engine it was preceded by different and comparatively simpler machines of the smooth muscle-fibre and the cardiac muscle-fibre. Normally, the striped muscle-fibre contracts with great rapidity and only upon stimulation by a nerve, while the smooth muscle, being less differentiated, appears to have retained more of its power of spontaneous contraction.

This simple form of zig-zags arranged at length uniformly throughout the body serves only for an animal like the primitive lancelet or *Amphioxus* or for a fish like the eel, the exact mode of locomotion of which has recently been described so admirably by Gray.[3] In most

[1] Sir Arthur Keith—*Engines of the Human Body*, 1926.

[2] Gregory, W. K.—*Basic Patents in Evolution*, 1930.

[3] Gray, J.—Studies in Animal Locomotion, (Eel.), *Journ. Exper. Biol.* 10, 1933.

modern fishes, these zig-zags adhere and unite into groups producing what we might call compound muscles. Structures like the tail and the pectoral and pelvic fins cannot be adequately worked by simple waves produced by muscle-segments arranged lengthwise. We thus get to the second stage; that of the grouping of simple muscle-segments, producing, so to speak, a high-powered 8-cylinder engine instead of the original one-cylinder engine of Daimler. Large powerful muscles of arms and legs in man or the flight-muscles in a bird afford the best examples of this large-scale grouping of muscle-fibres.

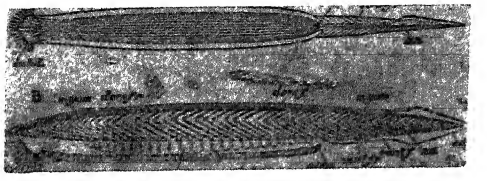

Fig. 3.—*Amphioxus*, ventral and side views.

A word about the general shape of the fish. At a very early period, the vertebrate body as a whole had been modelled into a "stream-line" form, a feature which is now becoming a vogue amongst motor-cars. Most fishes have a blunt rounded head and flowing contours passing behind into the rudder-like tail. A fish moving in water will need keels and rudders to steady and direct its forward progress and these were present in the most ancient and primitive known fishes, *i.e.*, the sharks of the Devonian period, as merely stiff folds of skin, called the fin-folds. These folds were probably just warped by the zig-zag muscles of the body and had the minimum of independent movement of their own, but in higher fishes, the bony rods supporting these fins fused together and formed the beginnings of the complex shoulder-girdle and fore-limbs and the hip-girdle and hind-limbs of land vertebrates. Usually the simple dorsal and anal fins retain their more primitive condition, while the pectoral and pelvic fins become limb-like, the pelvic becoming paddle-like and the pectoral acquiring a narrow wrist-like base capable of elaborate movements As the keel-like fin-folds acquired a skeleton, there was an extension of the segmental muscles and corresponding nerves towards them to direct their movements; that

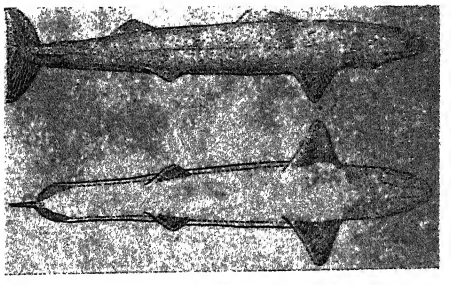

Fig. 4.—Devonian shark *Cladoselache*.

this actually happened is strongly supported by the fact that during the embryonic development of all higher vertebrates, including man, the fore- and hind-limbs develop from bud-like outgrowths involving folds of skin from the body-wall and an extension of the segmental muscles and nerves from the flanks.

We have so far been dealing with fishes and their progression in water. The next great step was the passage of our ancestors from water to land. This must have involved a series of experiments and inventions until the four-footed terrestrial vertebrate was evolved. We are agreed that land vertebrates have arisen from fish-like ancestors. Two most important changes must have occurred in the passage from water to land—(1) the origin of limbs and (2) the origin of lungs. Lungs and legs, in fact, are the characteristic marks of a land vertebrate. The problem, therefore, is to explain how the walking four-footed animal evolved from the swimming fish, such as we have on the screen now, without any sudden alteration of the structure and function of its parts, by a series of gradual steps, each of advantage in the struggle for existence.[1]

We have already seen that a typical fish swims principally by the undulations of its body and tail and is helped by its paired fins, which are stiff folds of its body-wall, each with an internal skeleton movably articulated at its base to the supporting limb-girdle. The walking limbs of the earliest land-animal, which by common consent must have been an Amphibian, consist of paired pectoral and pelvic projecting limbs built essentially on the same plan, and each subdivided by movable articulations into three regions, the outermost bearing typically five digits, the limb being therefore called a pentadactyle limb.

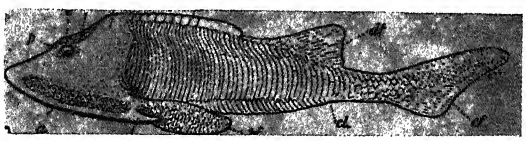

Fig. 5 —*Cephalaspis.*

Two questions immediately present themselves:—(1) From what kind of fish could land-animals have evolved? What group of fish is sufficiently advanced and at the same time sufficiently primitive to give rise to land-forms? and (2) What was the earliest land-form like? As regards the first question, it is now agreed that

[1] Goodrich, E.S.—The Origin of Land Vertebrates, *Nature*, 1924.

lobe-finned fishes and the Dipnoi, as shown in Fig 6., formed the starting point. Both these types of fishes are fresh-water forms and it is probable that the transition from aquatic to terrestrial life took place in streams and pools, in fresh-water rather than in sea, because it is in fresh-water that access to land was easy. Dipnoi and possibly the Osteolepids alone amongst the fishes have pectoral and pelvic fins of the same structure—sufficiently alike to have given rise to paired walking limbs. In other fishes, the pelvic fins are too much reduced or specialised, too unlike the pectorals, to have developed into the hind-limbs of a land vertebrate. Further, the Dipnoi alone of all fishes show an additional ascending process separating the profundus from the maxillary branch of the 5th nerve, besides basal and otic processes, by means of which the hinder region of the palato-quadrate bar is firmly attached to the skull.[1]

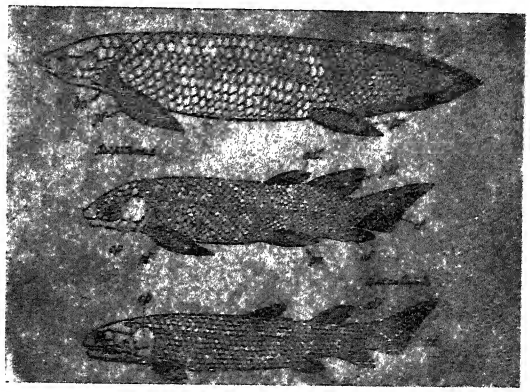

Fig. 6.—*Ceratodus*, *Dipterus* and *Osteolepis*.

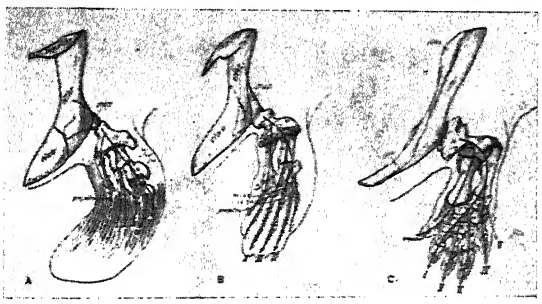

Fig. 7.—Pectoral girdles and appendages.

Having settled the type of the progenitor of the land-forms we turn to the second question—Which of the Amphibia came first? It is well known that all the modern forms of the Amphibia—frogs, newts, salamanders, etc.,—are highly specialised, although they retain a few essentially primitive characters, *e.g.*, they still lay their eggs in water and pass through a larval stage provided with gills. For the earliest Amphibian we have to go to the ancient and primitive Stegocephalians (Labyrinthodontia) which flourished in the Carboniferous and Permian times. They

1 Goodrich, E.S.—The Origin of Land Vertebrates, *Nature*, 1924.

formed a large assemblage, and, according to Professor T.H. Huxley, some of them "pottered with much belly and little leg, like Falstaff in his old age, among the coal forests."[1]

The question of the substitution of aerial for aquatic respiration in land vertebrates need not detain us long. Even the living Dipnoi, while retaining gills and gill-slits, have become adapted to survival in rivers liable to be dried up or to become foul in dry weather by acquiring a nasal passage from external to internal nostril (by closure of the nasal groove) and a lung for breathing air taken in at the surface. Goette and Spengel have suggested that the lung was probably derived from a posterior pair of gill-pouches which failed to open to the exterior, retained an ample blood-supply and joined together ventrally. To this day, in land-forms the lung first appears as a pair of diverticula of the pharynx; thus, if we derive the lung from the posterior pair of gill-pouches, it would have no sudden origin and would fit in with the series of gradual steps leading from an aquatic to a terrestrial existence.[2]

Fig. 8.—Transition from water to land.

The first step towards lung had been taken when the bony fishes developed an air-bladder, but the actual steps by which the fin was changed into a leg have not been discovered yet; a lucky geologist may find traces of these steps in the Devonian era at some future date.[3]

The next step in the evolution was the transition from an amphibian to a reptile. This transition involved at least two new basic inventions: (1) a tough dry skin which was not subject to desiccation and (2) a shelled drought-resisting egg which contained not only plenty of food-material but also a little pond inside the amnion that enabled the embryo to do away altogether with the need of resorting to water.[3] Geologists tell us that towards the close of the Carboniferous period, the swamps and the steaming forests began to disappear and in their place dry land arose and set a premium on the development of full adaptation to life on land. Just as necessities of war have led to a quick development of

[1] Wells, Huxley and Wells—*The Science of Life*, 1931.

[2] Goodrich, E. S.—*Studies in the Structure and Development of Vertebrates*, 1930.

[3] Wells, Huxley and Wells—*The Science of Life*, 1931.

the aeroplane, similarly drought in the first instance and the disappearance of lakes and lagoons later led to the full emergence of land vertebrates, which at once took to feeding on the luxurious vegetation existing on land at the time.[1]

In water, the skin was moist and thin but on land you need a tough skin like that of a politician; a politician has to be resistant towards abuse and misrepresentation, a game which animals do not indulge in; an animal's skin has to be resistant to drought.

The primitive land-vertebrate (Stegocephalian) had its body suspended between the shoulder-girdle and the hip-girdle by muscular straps

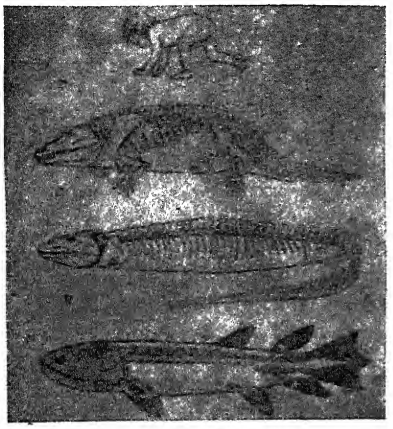

Fig. 9.—Evolution of limbs from fins.

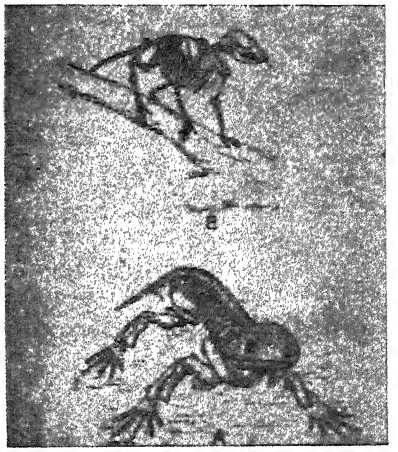

Fig. 10.—Limbs of a Cotylosaur and Opossum.

and the whole structure rested in turn on the limbs which were widely bent outwards in order to check any undue tendency for the body to fall over on its side. Gradually the body was lifted completely off the ground and the animal, instead of using its zig-zag muscles of flank, now relied for its propulsion exclusively upon the extension of its limbs. From the very first, the limbs acted as jointed compound levers which were alternately folded up and extended in the same way as we extend and fold up our own legs in walking. Once the primitive land-living type of organisation had been achieved, the subsequent changes in the skeleton from the earliest reptile to man introduced no major changes in the basic plan, however great were the advances in the ways of living and in the mental life.[2]

[1] Wells, Huxley and Wells—*The Science of Life*, 1931.

[2] Gregory, W. K.—Twenty-five Stages of Vertebrate Evolution, *Science*, 1933.

The most primitive reptiles were the Cotylosaurs, as shown in the slide before us, survivors of an ancient stock from which diverged birds and mammals and ourselves. The Reptiles flourished in abundance in the Miocene age which is styled the Golden Age of Reptiles, during which they reached their greatest elaboration and their greatest size. We are not directly concerned at present with giant-forms like *Brontosaurus* and *Diplodocus* but shall pass on to humbler but all the same most remarkable reptiles—the Theriodonts, so called because they were the first vertebrates to show in a well-developed manner the division of the teeth into different groups—molars, canines and incisors, so characteristic of mammals.

Fig. 11.—Cotylosaur, Theriodont, Opossum.

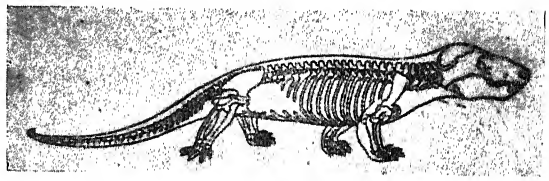

Fig. 12.—A Theriodont.

In these mammals the body was raised clearly off the ground, the feet were brought under the body and the elbows and knees were drawn in at the sides. They were probably insect-eating forms with low types of brain and a primitive type of skeleton. During the later Miocene and early Eocene periods, some of these smaller mammals began the habit of climbing trees—a habit which is deeply impressed upon the skeleton of monkeys and apes—a group to which man belongs. So long as progression was limited to the ground, the task of propelling the body with movable legs was comparatively simple. But in proportion as the early mammals succeeded in climbing trees and in leaping and running among the branches, the problem became more and more complex, especially in the devices necessary for more accurate and speedy adjustments in balancing.

Fig. 13.—Gibbon.

Sir Arthur Keith, who has made far-reaching investigations on the anatomy of man-like apes, was astonished to find that the gibbon had

already solved the problem of bipedal upright progression to such an extent that in great many ways, its visceral arrangements were fundamentally identical with those seen in man.[1] Making the arms free for climbing purposes was a great step in the evolution of man—a very important invention, so much so that Sir Arthur Keith has invented a special term "*brachiation*" to describe progression by means of arms.

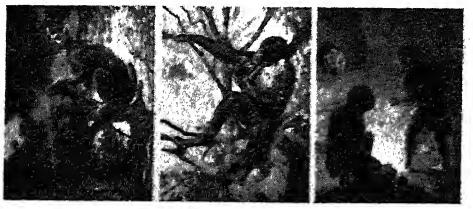

Fig. 14.—Apes and Man.

It is this brachiation[2] that has led to upright posture, the great distinguishing feature of man. In man, the hand is chiefly used for carrying and manipulating objects while in the apes it is still very largely used as an organ of locomotion. But the interesting fact remains that human hand still bears in its musculature the impress of the climbing habit of his ancestors: the slide before us shows the musculature of the hand of man side by side with that of an ape and we see the close correspondence between the two. Similar is the correspondence in the musculature of the foot. Biologists hold that this habit of brachiation led to the close connection between the pelvis and the legs and that led to the upright posture of man and this in turn has led to our progressive evolution in the struggle for existence. Clearness of eye, swiftness and sureness of foot on the one hand, memory, fore-thought and inventiveness on the other, are the results, direct and indirect, of our comparative independence from environmental conditions which began with our ancestors taking

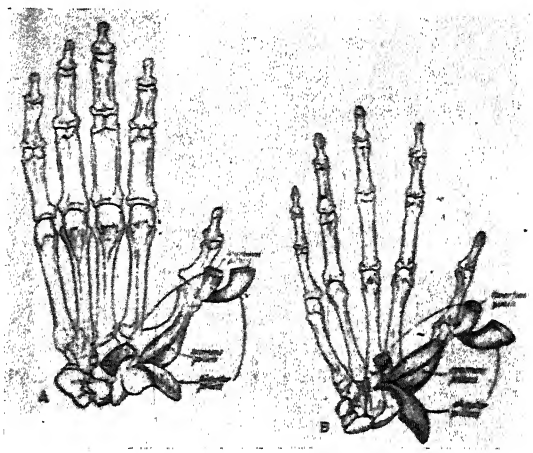

Fig. 15.—Ape-hand and Human hand.

[1] Gregory W. K.—'The Upright Posture of Man,'' *Proc. Amer. Phil. Soc.*, 1928.

[2] Gregory W. K.—The Origin of Man from a Brachiation Anthropoid Stock, *Science*, 1930.

to a climbing habit of life. Constant temperature and embryonic existence within the mother, conditions which we share with other mammals, provided delicate adjustments which in their turn enabled an elaborate and delicate brain-machinery to be developed.

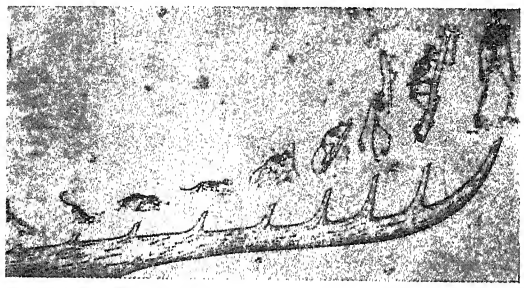

Fig. 16.—Series of skeletons from fish to man.

The series of forms which the stream of life has passed through in its evolution to man is shown in the accompanying figure.

This is the evolutionary record preserved in bones and bony fossils of our ancestral history. A great deal of this record is a record of struggle and destruction of rival forms. It is only in higher mammals and in apes that the family and the horde came into existence; then alone unselfish interest in others began to operate and led to the unselfishness of mothers, the devotion of fathers and the generosity and disinterestedness of friends. *Homo sapiens* is really a patch-work of both good and evil. But our past history makes us very optimistic about our future and in consideration of our cosmopolitan distribution, mankind should be a "good risk" for survival for an indefinite period.

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## ADDRESS BY DR. SIR LEWIS LEIGH FERMOR, Kt., O.B.E., D.Sc. (Lond.), A.R.S.M., M. Inst., M.M., F.G.S., F.A S B., F.R.S., DIRECTOR OF GEOLOGICAL SURVEY OF INDIA, INDIAN MUSEUM, CALCUTTA

DR. BAHL, LADIES AND GENTLEMEN,

I am glad to be present at the annual meeting of the Academy of Sciences of the United Provinces, and I am highly honoured at being asked to preside. In this I feel, however, that I am usurping the privilege of the President of your Academy and, in fact, I expostulated with your Honorary Secretary to this effect. He assured me, however, that it was the custom of the Academy that some one other than the President should be in the Chair on this occasion, and on referring to your Bulletins I find that in fact His Excellency Sir Malcolm Hailey, the Hon'ble Mr. J. P. Srivastava, and the Hon'ble Sir Shah Mohammad Sulaiman respectively presided at your previous three annual meetings.

What I view with special disfavour is the idea that the Chairman of the day should be expected to deliver an address in addition to that given by the President of your Academy. I should have taken comfort from the short addresses given on the first two occasions, were it not for the very interesting and lengthy address given by Sir Mohammad Sulaiman last year.

### The National Institute of Sciences of India

It seems desirable to say a few words about the new scientific organisation in India founded this January, namely, the National Institute of Sciences of India, especially as the success of this organisation will depend partly upon the extent to which the three bodies of academy rank in India, of which yours is one, enter into the scheme of co-operation. As you know, the National Institute of Sciences has been founded as a body of limited Fellowship,—limited not as to the total number of Fellows, but by the number to be elected annually. In this National Institute it is our hope gradually to enroll all the senior scientists of India, including all those whose work is of outstanding merit. The aims and objects of this new organisation have already been outlined by me in my inaugural

address to the National Institute, but I wish to emphasize here that it is not the purpose of this National Institute to compete with and undermine the activities of the three bodies of Academy rank in existence in India, namely, in order of formation, the Asiatic Society of Bengal, your Academy, and the Indian Academy of Sciences founded at Bangalore. These three bodies, all have all-India aspirations, but in virtue of their geographical distribution, they may be regarded as, for practical purposes, effecting a convenient geographical partition of India with suitable spheres of influence. These three Academies are available to satisfy the continuous needs of the scientists of all sciences in various parts of India for philosophers' gardens where men may meet and discuss their views and problems, particularly their problems of common interest, as distinct from the specialist matters more suitable for the specialist societies for particular sciences.

The chief task of the National Institute will be to act as an organising body for scientific effort in India and as a co-ordinating body, in the first place to the labours of the Academies: for, with the Academies, it represents the need for bodies of a general nature to counteract the growing trend towards specialisation in science in India, as in all countries. At present, as the National Institute is but newly founded, we are cautiously treading our way, and the fellows of the National Institute must not expect too much during the first year; but I anticipate that it will soon be found that there are many problems and tasks that can suitably be entrusted to the National Institute, with the expectation that the Institute, with the brains of the whole of scientific India at its disposal, will be able to arrange to the best advantage for the solution of the problem or the organisation of the task.

Although the formation of the National Institute must be regarded as a natural necessity for the purpose of counter-acting to some extent the trend towards specialisation, yet there is still a need and a place for specialist societies, and none of them need view with any apprehension the foundation of our co-ordinating body; instead, they will find, in the not distant future, that we shall be calling upon not only for their co-operation.

I am sure, however, that you do not wish to hear only about the new organisation, but would instead like to have a few words concerning my own special branch of knowledge, namely, geology.

In 1934, Behar and Nepal were, as you know, shaken by a very serious earthquake, namely, the Great Earthquake of the 15th of January, 1934. An earthquake, although it must originate in a definite spot, does

not confine its effect to its origin, for it operates, as you know, by the propagation of earth waves of various types. The occurrence of these waves is recorded by seismographs often upon great distances from the source, whilst when the shock is sufficiently severe the waves are also perceived or felt by man though to a much smaller distance from the source. It is calculated that the earthquake of last January was strong enough to be felt by man over 1,900,000 square miles of country, whilst it was recorded by the seismographs of the whole world. Although the United Provinces was not the worst sufferer, yet this province was close enough to the source for serious effects to be produced in many of your towns. You are, therefore, practically interested in the cause of earthquakes, and a few words from me on this point may prove of interest.

It is generally agreed that earthquake shocks are due to movements within the earth's crust. Some shocks can be shown to be directly related to the dislocations in the earth's crust that geologists term 'faults' and, in fact, in some earthquakes small faults are seen to be produced visibly at the surface as a result of the earthquake, as for example, in the great earthquake of Assam in 1897. In cases where earthquakes can be directly ascribed to movements along faults, it is safe to say that they represent the sudden relief of strains that have been accumulating for some time in regions subjected to tectonic stress, the strength of the earth's crust having permitted the accumulation of strains which otherwise would have been relieved as rapidly as produced.

### Gangetic Alluvium Underloaded

The epicentral tract of the great earthquake of last January was, however, in a tract where no consolidated rocks appear at the surface, for it was in the middle of the Gangetic alluvium, which masks completely the nature and structure of the underlying more consolidated rocks. We can surmise what these rocks may have been, but we do not know if we are right, for no bore holes have ever penetrated the Gangetic alluvium except near its edges, and there are reasons for supposing that this alluvium is many thousands of feet thick. In the absence of knowledge it is, however, possible to speculate that, as is known in many other cases, this great earthquake was due to some fault movement in the more consolidated rocks below the alluvium representing the partial relief of accumulated strains. That this may possibly be the truth will be realised when I mention that according to the geodetic observations of the Survey of India, this portion of the Gangetic alluvium suffers from a deficiency of gravity, or is underloaded.

It is possible by a study of the records of seismographs at various distances from the focus to deduce roughly the depth of the focus of an earthquake; and it is found that whilst many of the earthquakes of the world have originated at foci situated close to or within a few miles of the surface, some earthquakes have originated at much greater depths,—at depths so great indeed that it seems probable that the rocks there must be, on account of high temperatures and pressures, in a more plastic condition than those nearer the surface, and probably unable, therefore, to accumulate strains due to tectonic earth movements. For these deeper earthquakes, therefore, it seems necessary to look for a different type of cause, than the relief of tectonic strain.

## Garnets

Such a cause I was able to suggest many years ago—the suggested cause being a rapid change in volume of deep-seated rocks due to the passage of one mineral phase to another. This leads me to what appears to be an incongruous change from discussing earthquakes to discussing garnets. The mineral garnet is, as some of you know, one of the most condensed minerals with which the geologist has to deal. It is complex silicate of high density belonging to the cubic system; and in a paper published many years ago entitled "Garnet as a Geological Barometer"*, I indicated crudely the extent to which the presence of garnet in rocks might be taken as an indication of the application of pressure, and I amused myself considering what would happen to various rocks if they were subjected to pressures and temperatures high enough to cause the maximum production of garnet. It is interesting first to consider the common rock basalt, which almost all geologists now agree forms a continuous shell of the earth below the more acid rocks of the crust. It is this shell which, when tapped, gives rise to the vast basaltic lava flows that have overwhelmed the surface of the earth in so many countries. In India we have the largest of all these manifestations, namely, the Deccan Trap, covering some 200,000 square miles of Western India. These lavas reached the surface not through volcanoes of the central type, but through fissures coming from unknown depths, and now represented at the surface by dykes of basalt and dolerite: we must picture the molten rock as having come from 10 or 20 miles below, as the result of some release of pressure. Normally pressures at

* 'Preliminary Note on Garnet as a Geological Barometer and on an Infra-Plutonic Zone in the Earth's Crust,' Rec., Geol.-Surv. Ind., XLIII, pp. 41-47, (1913).

such depths are so great that it appeared incredible that a rock of basaltic composition could at such a depth below the surface exist actually as basalt, that is as a rock made of labradorite felspar, augite, and iron-ore. In fact, my suggestion was that at that depth the rock of basaltic composition would be present in the form of eclogite which is a highly garnetiferous rock of similar chemical composition to basalt, but composed normally of pyroxene, garnet, and rutile, and consequently of much higher specific gravity. Calculations show that the eclogites and related garnetiferous rocks occupy from 10 to 20 per cent less volume than the corresponding basalt or gabbro, so that whereas the density of basalt is 2·9 to 3·0, the density of eclogite is about 3·4 to 3·5.

### Conditions Below Earth's Crust

General considerations indicate that the reactions by which garnets would be formed from the minerals of basalt must be endo-thermic ones. This means that the conditions that would cause basalt or gabbro to pass into eclogite, should be conditions requiring decrease of volume and absorption of heat. These are exactly the conditions that must prevail at considerable depths in the earth's crust, and it seems philosophically sound, therefore, to suppose that the lower portion of the basaltic shell of the earth's crust must be in eclogitic phase; and further that there must be a zone where the two rocks meet, in which passages from basalt to eclogite and the reverse must be taking place periodically according to change of pressure; and that, in fact, in this layer we have a cushion by means of which isostatic adjustments of the earth's crust can be effected, the passage of eclogite to basalt or gabbro leading to the elevation of the surface and the passage of basalt or gabbro to eclogite to a sinking of the surface. Once one accepts the philosophic necessity of the presence of the shell of eclogite (my infraplutonic zone)—a hypothesis which has not yet been accepted by all geologists, as some prefer to think in terms of peridotite rather than eclogite—it is possible to put forward explanations of isostasy, vulcanicity and earthquakes, and even of the formation of chondritic meteorites. These are all fascinating branches of this speculation, and ones upon which I have expressed preliminary views elsewhere, but the one which concerns us just now in the possible explanation of deep-seated earthquakes. Deep-seated earthquakes appear to require sudden increases of volume at some depth below the surface, and the only possible way in which this increase of volume can be provided appears to be by some rapid change of mineral phase. The question is whether the passage of eclogite to basalt can

provide this explanation. The possibility of this explanation being correct depends first upon the possibility of there really being an eclogitic shell, and this depends upon the possibility of the stability of the garnet, which is a somewhat easily fusible mineral, at the high temperatures that prevail at the depths in question. We have, however, ocular evidence of the ability of eclogite to exist at considerable depths in the form of the blocks of eclogites contained in the diamond pipes of Kimberley in South Africa; and allowing for the fact that the melting point of garnet probably increases with pressure, it seems likely that garnet and consequently eclogite can persist at such considerable depths. If this be accepted then it is obvious that there must be places where the garnet is kept solid in spite of the high temperature only by the prevailing pressures, and that with any slight release of pressure the garnet must immediately become unstable. The question is whether such instability developed over a large mass of rocks could produce explosive results competent to cause an earthquake shock.

## A Talisman

Having made this suggestion, which is really reviving a suggestion of the past, I prefer to leave the subject, as I have already encroached upon your time. But this I will say; this garnet hypothesis may be regarded as an illustration of a possibility. If, in fact, garnets are unable to exist at the depths in question, nevertheless the possibility of explaining deep-seated earthquakes, by sudden changes of mineral phase still exists, and it is the principle rather than the details that is important. Whilst on this subject, however, I must express a slight apology in that having launched on these interesting speculations concerning earthquakes, vulcanicity, isostasy and meteorites so long ago as 1910, I have not developed the subject further. The reason, of course, is that the systematic field work of a Geological Survey geologist, coupled with administrative work when at headquarters, makes it difficult to sufficient attention to theoretical speculations. During the years that have elapsed I have, however, kept my eyes open, and nothing that has been published on these four subjects appears to me to render my early speculations improbable, and to me, through all these years in the jungle, the mineral garnet with its fascinating possibility has always been to me a talisman helping to throw light upon problems connected with the structure of the earth's crust.

## VOTE OF THANKS TO PROF. K. N. BAHL AND PROF. A. C. BANERJI

In proposing the vote of thanks to Prof. K. N. Bahl and Prof. A. C. Banerji, Dr. P. L. Srivastava spoke as follows:—

On behalf of the U. P. Academy of Sciences, I consider it a privilege to rise to propose a hearty vote of thanks to Dr. Bahl, our retiring President, and Prof. A. C. Banerji, our retiring Secretary. Dr. Bahl has been associated with our Academy since its very inception. In fact he is one of the founders of the Academy, and it was in the fitness of things that he succeeded Dr. Saha who was our first President. During the two years that Dr. Bahl was our President, he guided the activities of the Academy with great tact and resourcefulness. He took a keen interest in its affairs and came to Allahabad on several occasions to preside over our meetings at considerable sacrifice. The Academy cannot be sufficiently grateful to him for all that.

As regards Prof. Banerji, it is impossible for me to express the gratitude of the Academy to him in adequate words. To Prof. Banerji goes the credit of doing the entire spade work and of keeping the Academy in working order for four long years. He gave a lot of his precious time and energy to the work of the Academy. But for him the Academy would not have achieved the success that it has done. If Dr. Saha has been the brain of the Academy, Prof. Banerji has been its very soul.

Gentlemen, it is with the greatest pleasure that I propose a hearty vote of thanks to Profs. Bahl and Banerji.

Dr. Tarachand seconded the above vote of thanks.

## VOTE OF THANKS TO Dr. SIR L. L. FERMOR

In proposing a vote of thanks to Dr. L. L. Fermor, Prof. M. N. Saha said:—

It has indeed been very kind of Dr. Fermor to have agreed to come at such a short notice to Allahabad and preside over our Annual function. Dr. Fermor came to India nearly 33 years ago, as an officer in the Geological Survey of India of which he is the Director now. His contribution to the Science of Geology is recognised all over the world, and as mark of recognition of his eminence as a Geologist, the Royal Society has recently elected him as one of its fellows. His connection with

Indian Scientific men has been very intimate and he has regularly attended the meetings of the Indian Science Congress, and was its General President in 1933 at Patna.

My personal acquaintance with Dr. Fermor dates from the year 1934, when I met him for the first time at the Bombay Science Congress and fate drew us together in the work of organisation of the National Academy of Sciences for the whole of India, he as president and myself as secretary of Academy Committee appointed by the Indian Science Congress. I need hardly repeat here the story of fight and struggle we had to go through in bringing the National Institute of Sciences for India, which is to act as National Academy, into existence. Suffice it to say that we found that the land mass we call India, not only consists of geological formations widely varying in chemical composition and physical characteristics, but we found that ethnological India was also composed of different stratas widely differing in their outlook, ideals and objectives. To evolve an order out of a chaos of divergent interests appeared at times almost an impossible task, but our distinguished friend rose equal to the occasion and probably his knowledge of geology was responsible for this unique achievement. The National Institute of Sciences, founded at Calcutta in January, 1935, is a striking monument to his patience, forbearance and tact.

To-day the U. P. Academy of Sciences celebrates its fifth anniversary. Let us hope that it will cooperate with the National Institute in bringing about unity in the ranks of Indian Scientists and promoting the knowledge of science in this country.

We are very grateful to our friend for having come here and presided over our annual gathering. I invite you all in according him a hearty welcome and in proposing a hearty vote of thanks.

In seconding the vote of thanks to Dr. Fermor, Dr. H. R. Mehra said :—

I have great pleasure to second the vote of thanks proposed by Prof. M. N. Saha to Dr. Fermor, who has come here from Calcutta to preside over the Annual Meeting and address us this evening. It is remarkable in the history of the Academy that we have for our president to-day an eminent scientist and a geologist of world-wide fame. Dr. Fermor is the first president of the National Institute of Sciences of India and as such we cannot expect a better authority than him to grace our meeting and encourage us in our humble beginnings. We already owe much to him in leading a way to bring the scientists of the country together under the National Institute of Sciences, in the creation of which

he has taken an active part. His efforts to bring about harmony among the scientists, who at one time appeared to show a hopeless disagreement in the founding of the Institute are well known and we are glad to say that they have met with great success through his great personality and tact. Dr. Fermor, we are sure, will always take a keen interest in our activities, as our Academy is a side branch of the central Institute of which he is the President. As far as Geology is concerned, it is more or less obvious that he will not find much in the Proceedings of the Academy, but we trust that his presence here today will direct the authorities to consider seriously the feasibility of opening a department for the teaching of this important science in our universities. It hink it is a high time that a start in this direction should be made.

It is a great pleasure to me to second once more the vote of thanks to Dr. Fermor, who has kindly taken the trouble to come over here for the Annual Meeting.

## AWARD OF THE EDUCATION MINISTER'S GOLD MEDAL

The Education Minister's Gold Medal was awarded to Dr. H. R. Mehra, Ph.D. of the Allahabad University, Allahabad for his paper entitled 'New Blood Flukes of the Family Spirorchidae Stunkard from Indian Fresh-water Tortoises' considered to be the best paper in Zoology and Medicine published in the Journal of the Academy of Sciences, U.P.

## INSTRUCTIONS TO CONTRIBUTORS

Article should be brief. The viewpoint should be comprehensive in giving the relation of the paper to previous publications of the author or of others and in exhibiting, when practicable, the significance of the work for other branches of science. Elaborate technical details of the work and long tables of data should be avoided, but authors should be precise in making clear the new results and should give some record of the methods and data upon which they are based.

**Manuscripts** should be prepared with a current number of the proceedings as a model in matters of form, and should be typewritten in duplicate with double spacing, the author retaining one copy. Illustrations should be confined to text-figures of simple character, though more elaborate illustrations may be allowed in special instances to authors willing to pay for their preparation and insertion. Particular attention should be given to arranging tabular matter in a simple and concise manner.

**References** to literature, numbered consecutively, will be placed at the end of the article and short footnotes should be avoided. It is suggested that references to periodicals be furnished in some detail and in general in accordance with the standard adopted for the Subject Catalogue of the International Catalogue of Scientific Literature, *viz.*, name of author, with initials following (ordinarily omitting title of paper), abbreviated name of journal, volume, year, inclusive pages.

**Papers** by members of the Academy may be sent to the General Secretary, Academy of Sciences of the United Provinces of Agra and Oudh, Allahabad, U.P. Papers by non-members of the Academy should be submitted through some member.

**Proof** will ordinarily be sent; and the author is requested to return the proof at his earliest convenience.